REMARKS

Claims 1-22 are pending in the present application. By this Amendment, the specification is amended to correct various minor typographical errors related to the referencing of the figures. Additionally, claims 1-8 are amended for the purposes of clarity and precision and to overcome the Examiner's objections. The amendments are not believed to be narrowing. Additionally, new claims 12-22 are added. For at least the reasons herein, Applicant respectfully requests withdrawal of the rejections, and allowance of the claims.

I. Objections

The Examiner objects to the specification and claims based on the allegedly undefined "superordination" and "subordination." As shown in the foregoing amendments, the application has been amended to overcome the Examiner's objections. Accordingly, Applicant respectfully requests withdrawal of the objections.

II. The claims are novel

Claims 1-11 stand rejected due to alleged anticipation under 35 U.S.C. § 102(b) over Inui et al. (U.S. Patent No. 5,363,125, hereafter "Inui"). Applicant respectfully submits that Inui fails to disclose all of the claimed features, as required for an anticipation rejections under § 102. Thus, Applicant respectfully requests withdrawal of the rejection, and allowance of the claims.

The presently claimed invention relates to an image recording method and apparatus for use in an extremely high-resolution system (e.g., 4,096 steps of gradation to produce an image of 12 bits). In the related art, one pulse per gradation step is required, as illustrated in Figure 1A.

However, as illustrated in Figure 1B, the presently claimed invention uses fewer pulses (e.g., 132 pulses for 4,096 steps of gradation), and various pulse widths. The pulses are generated by the recording controller 16 illustrated in Figure 2. Figures 4-7 illustrate exemplary embodiments of the presently claimed invention.

Inui discloses a shading correction method and device that reduces negative effects of accumulated heat energy in the recording head by controlling the width of the driving pulse based on the relative position of the pixel and the sub-line, as discussed at column 3, lines 13-24 of Inui. However, Applicant respectfully submits that the number of pulses is not minimized, as is the case in the claimed invention. For five different tonal shades, five different pulses (0-4) must be activated per pixel. See col. 3, lines 40-50. The one-to-one correspondence for gradation and pulses merely corresponds to the prior art.

Further, Applicant respectfully submits that there is no disclosure in Inui of a pulse having a larger width being used to express a superordination bit, and a pulse having a smaller width being used to express a subordination bit to express a single pixel. To the contrary, the correlation in Inui is between position of first and second bits rather than bit ordination for a single pixel.

Applicant respectfully submits that Inui fails to disclose or suggest all of the claimed combinations of features. For example, but not by way of limitation, Applicant respectfully submits that Inui fails to disclose expressing gradation using a first pulse expressing a superordination bit having a larger pulse width and a second pulse expressing a subordination bit having a smaller pulse width, as recited in independent claims 1, 4, 5 and 8.

Further, Applicant respectfully submits that Inui fails to disclose having an activation or a non-activation operation for each of the pulses, related to a specified bit forming image data, as recited in independent claims 3 and 7. In Inui, for recording of 01, one drive pulse is supplied for one sub-line. However, Applicant respectfully submits that each of the remaining pulses would not be set for this particular image data bit.

Applicant respectfully submits that the dependent claims are allowable for the same reasons as the independent claims from which they depend. Additionally, Applicant respectfully submits that Inui fails to disclose an irregular interval between pulses expressing the superordination bit, as recited in claims 2 and 6. Inui teaches regular intervals, corresponding to a pixel period between any bits of wider duration. Claims 2 and 6 are not believed to be anticipated for at least this additional reason.

III. New claims

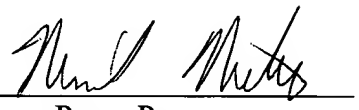
As shown in the foregoing amendments, Applicant has added new claims 12-22. Applicant respectfully submits that new claims 12-22 are allowable, and thus requests allowance thereof.

IV. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Please amend the paragraph bridging pages 2 and 3 as follows:

Incidentally, when a gradation image is recorded like this, each pixel is always recorded from a constant point (point "a" in Fig. [4A]3B). Since the point "b" side in a single pixel width in the transferring direction becomes no-recorded portion, the recorded image becomes concentrated on the point "a" side as above. Therefore, when a formed two-dimensional image is viewed over its entirety, there occurs a drawback that the image becomes conspicuously coarse.

Please amend page 11, 2nd full paragraph as follows:

Optionally, Table 1 shows three examples of combinations of pulse widths. Fig. [1]4 shows combination of 4,095 numbers of recording pulses when 4,096 steps of gradation are expressed.

Please amend page 16, 4th full paragraph as follows:

As shown in Table 2, in case of 132 steps of dispersion, the pulses P1, P2, ... P127 of 132 numbers of pulses of P1, P2, ...P132 are pulses each having a width of 32, and the subsequent pulses P128, P129, P130, P131 and P132 are pulses having widths of 1, 2, 4, 8 and 16 in order and that they correspond to using bits of 5,6,7,8,9,10, and 11 (i.e., superordination bits for the larger pulse width) and using bits of 0, 1, 2, 3 and 4, (i.e., subordination bits for the smaller pulse width) respectively.

Please amend paragraph bridging pages 20 and 21 as follows:

In this embodiment, then, the thermal patterns generated at neighboring pixels are shifted over and then recording is performed. Additionally, the number of heating elements being activated during each of the recording times is made substantially uniform. Specifically, particularly in the case of an image such as a solid image in which recording noise is easy to be generate, the positions of the heating elements made to be heated up are dispersed in correspondence to their corresponding pixel positions (i.e., the width direction at the time of performing recording), and also, are made to be uniform to each other with respect to time (i.e., the width direction at the time of recording), as shown in Fig. [3]7.

Please amend page 21, 1st full paragraph as follows:

Namely, as shown in Fig. [3]7, when dispersion-recording is to be performed from dispersion 0 to dispersion 131, control is performed so that (1) it is avoided that neighboring heating elements lie in the ON-status each time, and (2) the number of activated hearing elements 22 is Kept substantially uniform (see the figures in the rightmost column in the table).

Please amend page 21, 2nd full paragraph as follows:

Further, in Fig. [3]7, the number oil pulses having a width of 32 in the horizontal direction is counted (i.e., the chart shows the number of "ON-pulses" at each recording time), and it is evident that the number of pulses lying in ON-status at each recording time is 47-49, being substantially the same number. This indicates that voltage during each of the times is little changed, and therefore, voltage drops are also small.

Please amend the paragraph bridging pages 21-22 as follows:

Additionally, as shown in Fig. [3]7, the number of activated pulses is 47-49, being substantially the same number, so that the number of heating elements lying in ON—status at each of the times, are mutually substantially same. Therefore, the amount of the thermal film surface layer burned-in caused by heat keeps constant, resistance (a type of frictional resistance) when the film is transferred does not change, and generation of sound (namely recording noise) when transfer is suppressed.

Please amend the paragraph bridging pages 22-23 as follows:

More specifically, by dispersion-recording the image in a way such as shown in Fig. [3]7, the timing when the neighboring pixels are heated up, is shifted, and the number of pulses activated at each timing is kept substantially the same, so that a voltage drop may be suppressed and fluctuations in sticking between the recording layer and the thermal head are decreased, producing the result that the transfer of the film can be smoothed and the recording noise can be decreased.

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) An image recording method of recording a single pixel forming an image using a plurality of pulses comprising the step of:

expressing gradation using a [single]first pulse [or a plurality of pulses] expressing a superordination bit having a larger pulse width and a [single]second pulse [or a plurality of pulses] expressing a subordination bit having a smaller pulse width.

2. (Amended) [An]The image recording method according to claim 1, said [plurality of pulses]first pulse expressing said superordination bit having said larger pulse width lying at irregular intervals applied to said single pixel.

3. (Amended) An image recording method of recording a single pixel forming an image using a plurality of pulses, comprising the step of:

having activation or non-activation operation for each of said pulses, related to a specified bit forming image data.

4. (Amended) An image recording method comprising the steps of:

expressing gradation using a [single]first pulse [or a plurality of pulses] having a larger pulse width expressing a superordination bit and a [single]second pulse [or a plurality of pulses] having a smaller pulse width expressing a subordination bit; and

having activation or non-activation operation for each of said pulses, related to a specified bit forming image data.

5. (Amended) An image recording apparatus comprising:

an image recording unit which records an image in a first direction;

a transfer unit which relatively transfers said image recording unit and a recording medium in a second direction normal to said first direction; and

a record control unit which controls and records a single pixel using a plurality of pulses when said image [are]is recorded, said record control unit expressing gradation for said image to be recorded using a [single]first pulse [or a plurality of pulses] having a larger pulse width

expressing a superordination bit and a [single]second pulse [or a plurality of pulses] having a smaller pulse width expressing a subordination bit.

6. (Amended) [An]The image recording apparatus according to claim 5, said [plurality of pulses]first pulse expressing said superordination bit having said larger pulse width lying at irregular intervals applied to said single pixel.

7. (Amended) An image recording apparatus comprising:

an image recording unit which records an image in a first direction;

a transfer unit which relatively transfers said image recording unit and a recording medium in a second direction normal to said first direction; and

a record control unit which controls and records a single pixel using a plurality of pulses when said image is recorded, said record control unit having activation or non-activation operation for each of said pulses, related to a specified bit forming image data.

8. (Amended) An image recording apparatus comprising:

an image recording unit which records an image in a first direction;

a transfer unit which relatively transfers said image recording unit and a recording medium in a second direction normal to said first direction; and

a record control unit which controls and records a single pixel using a plurality of pulses when said image is recorded, said record control unit expressing gradation for said image to be recorded using a [single]first pulse [or a plurality of pulses] having a larger pulse width expressing a superordination bit and a [single]second pulse [or a plurality of pulses] having a

smaller pulse width expressing a subordination bit, and having activation or non-activation operation for each of said pulses, related to a specified bit forming image data.

Please add new claims 12-22.